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The Productivity Gap between Europe and the United States: Trends and Causes

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The benefits of the modern knowledge economy differ greatly between advanced economies. Average annual labor productivity growth (measured as GDP per hour of work) in the United States accelerated from 1.2 percent in the 1973–1995 period to 2.3 percent from 1995 to 2006. Conversely, the 15 European Union countries that constituted the union up to 2004 experienced a productivity growth slowdown between these two time periods. For these 15 countries as a group, labor productivity growth declined from an annual rate of 2.4 percent during the period 1973–1995 to 1.5 percent during the period 1995–2006. While differences in the timing of business cycles in the United States and the European Union may have some effect on this comparison, they do not explain these divergent trend growth rates.

This paper shows that the European productivity slowdown is attributable to the slower emergence of the knowledge economy in Europe compared to the United States. We consider various explanations which are not mutually exclusive: for example, lower growth contributions from investment in information and communication technology in Europe, the relatively small share of technology-producing industries in Europe, and slower multifactor productivity growth (which can be viewed as a proxy for advances in technology and innovation). Underlying

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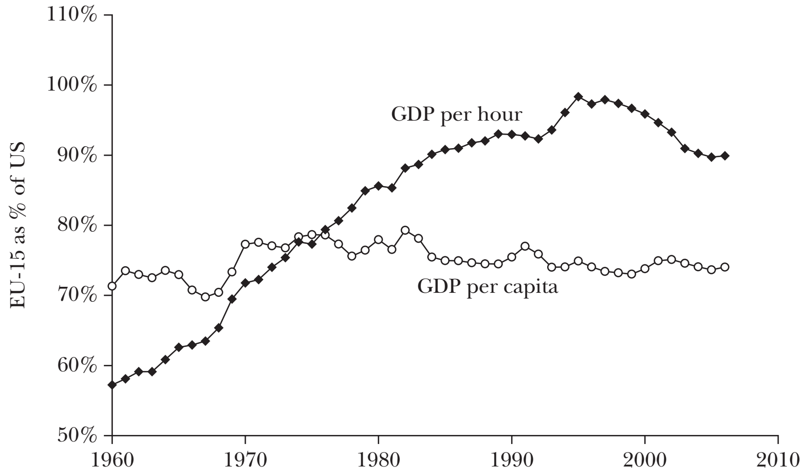
these explanations are issues related to the functioning of European labor markets and the high level of product market regulation in Europe. The paper emphasizes the key role of market service sectors in accounting for the productivity growth divergence between the two regions. We argue that improved productivity growth in European market services will be needed to avoid a further widening of the productivity gap.

Slower labor productivity growth in Europe than in the United States since 1995 reverses a long-term pattern of convergence. The first section of this paper reviews the productivity performance in Europe since 1950, considering three periods characterized by different drivers of productivity. In the period 1950–1973, European productivity growth was characterized by a traditional catch-up pattern based on the imitation and adaptation of foreign technology, coupled with strong investment and supporting institutions. However, the traditional postwar convergence process came to an end by the mid 1970s (Crafts and Toniolo, 1996; Eichengreen, 2007). Then, in the period from 1973 to 1995, productivity growth in both Europe and the United States began to slow. However, Europe's productivity growth remained faster than in the United States. During this time, Europe experienced a strong decline in labor force participation and a fall in hours worked, which in turn triggered a substitution of capital for labor bringing capital–labor ratios in some major European economies to levels well above those of the United States by the mid 1990s. Finally, in the period since 1995, U.S. productivity growth accelerated, while the rate of productivity growth in Europe fell.

We then focus on the European productivity experience, especially in the period since 1995, using a new and detailed database called the EU KLEMS Growth and Productivity Accounts. The level of detail in this database allows explicit consideration of a number of issues: changes in patterns of capital–labor substitution; the increasing importance of investment in information and communications technology; the use of more high-skilled labor; the different dynamics across industries, like industries producing information and communications technology, or manufacturing and services more generally; and the diversity of productivity experience across the countries of Europe.

Finally, we consider whether Europe will be able to accelerate its productivity growth. The slowing growth and faltering emergence of the knowledge economy in Europe over the last decade has led to an ambitious action program of the European Commission, called the "Lisbon Agenda," which was launched in 2000. Its goal was to make Europe by 2010 "the most competitive and dynamic knowledge-based economy in the world." This agenda stressed the need to raise private and public spending on research and development (leading to an "official" target that research and development expenditures should rise to 3 percent of GDP) and the creation of more jobs (raising the employment rate among adults to 80 percent), especially high-skilled jobs. This agenda also stressed the need to open up sheltered and protected sectors to greater competition, to improve the climate for enterprise and business, to reform labor markets, and to move toward environmentally sustainable growth. So far, the Lisbon Agenda is not living up to its ambition.

Figure 1
Total Economy GDP per Hour Worked and GDP per Capita in EU-15, 1960–2006
(relative to the United States)



Source: The Conference Board and Groningen Growth and Development Centre, Total Economy Database, January 2007, at ⟨http://www.ggdc.net/dseries/totecon.shtml⟩.
Notes: EU-15 refers to the 15 countries constituting the European Union before 2004 and include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom. The EU has expanded to include ten new member states mainly in Central and Eastern Europe in 2004 and another two in 2007; the new members are not included here. Relative levels are based on purchasing power parities for GDP for 2002 from the OECD.

For example, the European Commission (2004) and Aghion et al. (2004) explicitly address the need to speed up the process.

There is no explicit productivity growth target formulated in the Lisbon Agenda, but trends in labor productivity are monitored as one of its main indicators. Although we do not identify a silver bullet to revive productivity growth in this paper, we argue that the issue for European productivity growth is centered around the European services sector. The nations of Europe need to find their own ways of adjusting to the opportunities and dislocations of the new information and communications technologies. Thus, within the broader Lisbon Agenda, we would emphasize greater labor mobility and flexibility of service product markets within and across countries as being especially important.

European and U.S. Productivity: 1950–2006

Europe's growth performance relative to the United States since 1950 can be usefully divided into three periods: 1950–1973, 1973–1995, and 1995–2006. The comparative European experience in GDP per capita and in GDP per hour is illustrated in Figure 1. The measures are compared relative to the U.S. levels and are adjusted for differences in relative price levels using the GDP-based purchasing power parities for 2002 from the OECD.

European Catch-Up: 1950–1973

During the first period, from 1950–73, rapid labor productivity growth in the European Union went together with catching-up in terms of per capita income levels with the United States. The reasons for this dual catching-up process during the 1950s and 1960s have been extensively discussed in the literature and can broadly be divided into two groups: technology imitation and new institutions (for example, Boltho, 1982; Crafts and Toniolo, 1996; Eichengreen, 2007).

Imitation of technology and incremental innovation allowed European countries to speed up growth and productivity quite rapidly following the Depression of the 1930s and the devastation of Europe's economies during World War II. Many European countries could draw upon their legacy as industrializing nations during the nineteenth and early twentieth century. Compared to other parts of the world, Europe after World War II already had a relatively well-educated population and a strong set of institutions for generating human capital and financial wealth, which allowed a rapid recovery of investment and absorption of new technologies developed elsewhere, notably in the United States.

This process was strengthened by the emergence of a new set of institutions in the area of wage bargaining (Eichengreen, 2007). Although there were important differences between countries, essentially these arrangements involved limiting wage demands in exchange for a rapid redeployment of profits for investment. Through this arrangement, a consensus was developed between workers and capitalists that benefited both productivity and per capita income. In addition, European capital markets favored the emergence of large "national champion" companies while at the same time (notably in Germany) supporting a strong system of small- and medium-sized enterprises. In several northwest European countries, the education system tended to emphasize technical and vocational training. These characteristics of European institutions largely lasted until the end of the 1960s, after which labor markets became increasingly tight, leading to substantially higher wage demands.

The Productivity Slowdown: 1973–1995

The "golden age" of post–World War II growth came to an end rather abruptly in the early 1970s, followed by a period of significantly slower growth lasting almost two decades on both continents (Maddison, 1987). Table 1 shows that while U.S. GDP growth slowed from 3.9 percent on average per year in the period 1950–1973 to 2.8 percent in the period 1973–1995, EU-15 growth slowed substantially more from 5.5 percent in the period 1950–1973 to only 2.0 percent in the period 1973–1995. However, average growth rates of per capita income between the United States and the EU-15 became quite similar at 1.8 percent between 1973 and 1995. Further details on the growth slowdown during this period are provided by Crafts and Toniolo (1996), Baily and Kirkegaard (2004), and Eichengreen (2007).

Table 1
Average Annual Growth Rates of GDP, GDP per Capita, and GDP per Hour Worked, EU-15 and United States, 1950–2006
(in percent)

	Growth in		
	GDP	*GDP per capita*	*GDP per hour worked*
1950–1973			
EU-15	**5.5**	**4.7**	**5.3**
US	3.9	2.4	2.5
1973–1995			
EU-15	**2.0**	**1.7**	**2.4**
US	2.8	1.8	1.2
1995–2006			
EU-15	**2.3**	**2.1**	**1.5**
US	3.2	2.2	2.3

Source: Calculations based on the Conference Board and Groningen Growth and Development Centre, Total Economy Database, January 2007, at ⟨http://www.ggdc.net/dseries/totecon.shtml⟩.
Notes: See Figure 1.

Looking back at Figure 1, one striking observation is that while per capita income in Europe hovered around 75 to 80 percent of the U.S. level between 1973 and 1995, the productivity gap between Europe and the United States continued to narrow. Indeed, average annual labor productivity growth in the EU-15 was still twice as fast as in the United States, at 2.4 percent in the EU-15 against 1.2 percent in the United States from 1973 to 1995. Thus, the labor productivity gap virtually closed from 25 percentage points in 1973 to only 2 percentage points in 1995, as shown in Table 2. In some European countries, including Belgium, France, Italy, and the Netherlands, GDP per hour worked was 10 percent or more above the U.S. level in 1995. In Europe, the combination of an unchanged gap in per capita income and a narrowing gap in labor productivity was related—by accounting identity—to a decline in labor force participation rates and a fall in working hours per person employed. Working hours per capita in the European Union countries declined from about equal the U.S. level in 1973 to only 76 percent of the U.S. level by 1995, as shown in Table 2.

A substantial literature has explored why Europe's labor market institutions have led to less work, in particular during the period 1973–1995. Blanchard (2004) stresses how the trade-off between preferences for leisure and work developed differently in Europe and the United States. Prescott (2004) estimates that the role of income taxes can account for virtually all of the difference in labor participation rates across European countries. Nickell (1997) shows that besides high payroll taxes, other labor market issues, such as generous unemployment benefits, poor educational standards at the bottom, and high unionization with little coordination

Table 2
Levels of EU-15 Relative to the United States
(in percent)

	1950	*1973*	*1995*	*2004*
GDP per capita	45.5	76.8	74.9	74.1
Hours worked per capita	115.2	101.9	76.2	82.1
GDP per hour worked	39.5	75.4	98.3	90.3
Capital input per hour worked*		82.3	97.0	90.0

Source: Calculations based on the Groningen Growth and Development Center Total Economy Growth Accounting Database (June 2005) as described in Timmer and van Ark (2005). Output and capital levels are converted by GDP purchasing power parities for 2002.
* Measured as capital services per hour worked. Entry for 1973 refers to 1980.

also play an important role in accounting for Europe's rise in unemployment since the mid 1970s. Europe's welfare state rapidly expanded in the 1970s, causing an increase in labor cost, a strong bias towards insiders in the labor market, and an increase in structural unemployment, in particular among youth and elderly workers.

One result of Europe's slowing growth in labor input was a rapid increase in capital intensity, as the rise in wages supported the substitution of capital for labor. Table 2 shows that Europe's capital stock per hour worked was at 82 percent of the U.S. level in 1973, but had reached almost equality with the U.S. level by 1995. Some European countries had a capital stock per hour worked which was more than 10 percent above the U.S. level in 1995, including Austria, Belgium, Finland, France, Germany, and the Netherlands. As a result, the high labor productivity levels in the European Union by the mid 1990s should be interpreted with care. Economists draw a distinction between labor productivity, which can be measured by GDP per hour worked, and multifactor productivity, which relates to the level of output after accounting for labor as well as capital inputs. As we will argue in more detail below, even though Europe experienced relatively strong growth in labor productivity, the growth in multifactor productivity was much lower. This indicates that Europe's higher labor productivity growth during this period may not have been so much the result of catch-up, access to superior technology, or even faster innovation, but can be largely attributable to accumulated labor market rigidities.[1]

[1] Using a model estimating diminishing returns to hours worked and employment, a recent study by Bourlès and Cette (2007) shows estimates of "structural" hourly productivity for several continental European countries that are 10–15 percentage points lower than "observed" productivity. While the results of such models may be sensitive to the specifications, these estimates are sufficiently large to assign some role to labor market institutions in explaining Europe's productivity convergence between 1973 and 1995.

Europe's Falling Behind: 1995–2006

Since the mid 1990s, the patterns of productivity growth between Europe and the United States changed dramatically. In the United States, average annual labor productivity growth accelerated from 1.2 percent during the period 1973–95 to 2.3 percent during 1995–2006. Comparing the same two time periods, annual labor productivity growth in the European Union declined from 2.4 to 1.5 percent. By 2004, GDP per hour worked in the EU was about 10 percentage points below the U.S. level. Europe's capital intensity levels have come down significantly as well, from 97 percent of the U.S. level in 1995 to 90 percent in 2004 (Table 2).

The slowdown in labor productivity may be related to the rapid growth in labor input in many European countries. During the late 1980s and 1990s, several European countries introduced labor market reforms and instigated active labor market interventions to bring long-term unemployed people to work and raise the participation rate. The slowdown in productivity growth and the decline in relative capital intensity in Europe since 1995 suggest the possibility that just as limited employment growth accompanied higher labor productivity in Europe in the 1973–1995 period, perhaps that pattern is reversing itself in the more recent time period (Gordon, 2004). While in the short run, labor productivity growth might decline due to the dampening of real wage growth and consequent reduction in the rate of substitution of capital for labor, it is unlikely that the elasticity of labor input on productivity would be large in the medium and long term.[2] According to Blanchard (2004), the employment–productivity trade-off would only exist under the assumption of stagnant output growth, which is an unlikely assumption for the medium and long run. Indeed, despite slowing productivity growth, the European Union has not experienced a large slowdown in GDP growth since 1995. A related argument is that increases in employment have raised the share of low-skilled workers in the workforce, causing labor productivity to decline. However, there are no signs of a significant slowdown in the skill level of the labor force, which would presumably arise if the underlying cause was a strong rise in low-skilled labor in Europe. On the contrary, the average skill-level of the employed labor force continued to increase during the past decade. Thus, the labor market is unlikely to be the main explanation for the slowdown in productivity growth.

When put into a comparative perspective, the productivity slowdown in Europe is all the more disappointing as U.S. productivity growth accelerated since the mid 1990s. The causes of the strong U.S. productivity resurgence have been extensively discussed (as a starting point, see Jorgenson, Ho, and Stiroh, this volume). In the mid 1990s, there was a burst of higher productivity in industries producing information and communications technology equipment, and a capital-deepening effect from investing in information and communications technology assets across

[2] Bélorgey, Lecat, and Maury (2004) estimate long-term productivity elasticities of −0.5 with regard to the employment rate and −0.35 with regard to hours worked per person. In contrast, McGuckin and van Ark (2005) find that the productivity response to a 1 percent rise in labor force participation is less than −0.3 and peters out in less than five years.

the economy. In turn, these changes were driven by the rapid pace of innovation in information and communications technologies, fuelled by the precipitous and continuing fall in semiconductor prices. With some delay, arguably due to the necessary changes in production processes and organizational practices, there was also a multifactor productivity surge in industries using these new information and communications technologies—in particular in market services industries (Triplett and Bosworth, 2006).

In Europe, the advent of the knowledge economy has been much slower since the mid 1990s. In the next section, we exploit a new database on industry-level growth accounts to develop a better view of how inputs and productivity have contributed to the change in the growth performance of European countries since 1995, in particular in comparison with the United States.

Growth Accounting for Europe and the United States

To assess the contribution of various inputs to GDP growth, we apply the neoclassical growth accounting framework pioneered by Solow (1957) and further developed by Jorgenson and associates (Jorgenson and Griliches, 1967; Jorgenson, Gollop, and Fraumeni, 1987). Using this framework, measures of output growth can be decomposed into the contributions of inputs and productivity within a consistent accounting framework. This approach allows researchers to assess the relative importance of labor, capital, and intermediate inputs to growth, and to derive measures of multifactor productivity growth. The output contribution of an input is measured by the growth rate of the input, weighted by that input's income shares. Under neoclassical assumptions, the income shares reflect the output elasticity of each input, and assuming constant returns to scale, they sum to one. The portion of output growth not attributable to inputs is the multifactor productivity residual. Multifactor productivity indicates the efficiency with which inputs are being used in the production process, and includes pure technological change, along with changes in returns to scale and in mark-ups. Multifactor productivity, as a residual measure, also includes measurement errors and the effects from unmeasured output and inputs, such as research and development and other intangible investments, including organizational improvements (Hulten, 2001).

Our growth decompositions are based on the March 2007 release of the EU KLEMS database. This new database provides harmonised measures of economic growth, productivity, employment creation, and capital formation at a detailed industry level for European Union member states, Japan, and the United States from 1980 to 2004.[3] In particular, this database contains unique industry-level

[3] The EU KLEMS database has been constructed by a consortium of 16 research institutes across Europe in close cooperation with national statistical institutes. The acronym KLEMS stands for capital (K), labor (L), energy (E), material (M), and services (S) inputs at the industry level. The database is publicly available at ⟨http://www.euklems.net⟩. For a short discussion of measurement of output, labor, and

measures of the skill distribution of the work force and a detailed asset decomposition of investment in physical capital. Labor input reflects changes in hours worked, but also changes in labor composition in terms of age, gender, and educational qualifications over time. Physical capital is decomposed into six asset categories, of which three are information and communications capital—including information technology hardware, communication equipment, and software—and three are capital that does not involve information and communications technology—machinery and equipment, transport equipment, and nonresidential structures. Residential capital, which does not contribute in any direct way to productivity gains, is excluded from the analysis.

The EU KLEMS database makes it possible for the first time to compare and analyze the role of high-skilled labor and information and communications technology capital for productivity growth at an industry level between countries. Our focus here is on the market economy, which means that we exclude health and education services, as well as public administration and defense.[4] This exclusion implies a faster acceleration of output growth in both the European Union and the United States since 1995 than for the total economy reported in the previous section, but the difference in pace of acceleration between the two regions does not change. Also, in the remainder of this discussion, the European Union only includes 10 countries, excluding Greece, Ireland, Luxembourg, Portugal, and Sweden from our original 15, because no industry-level accounts back to 1980 were available for these five countries.

Table 3 provides a summary of the growth contributions of factor inputs and multifactor productivity to labor productivity growth in the market economy in the ten European Union countries and in the United States for the periods 1980–1995 and 1995–2004. When comparing the period before and after 1995, the annual growth rate of output in the European Union accelerates, but the growth differential relative to the United States increases from 1.2 percentage points (1.8 percent in Europe versus 3.0 percent in the United States) to 1.5 percentage points (2.2 percent in Europe versus 3.7 percent in the United States). As described in the previous section, hours worked in the European Union grew rapidly after 1995, to some extent making up for the shortfall in the earlier period. In contrast, the growth in hours worked slowed down very substantially in the United States—in particular after 2000—even though the average growth rate in hours was comparable to that of the European Union between 1995–2004. As a result, labor

capital services in the EU KLEMS data, see the appendix that appears with the on-line version of this paper at ⟨http://www.e-jep/org⟩. For details concerning the construction of the database, see Timmer, O'Mahony, and van Ark (2007).

[4] While we recognize that some output of these sectors is provided by (semi)private institutions and that the extent of private industry's share varies across countries, we refer to these sectors as "nonmarket services." Measurement problems in the public services sectors are substantial, and in several cases (in particular for government), output growth is measured using input growth. We also exclude real estate (ISIC 70), because output in this industry mostly reflects imputed housing rents rather than sales of firms.

Table 3
Contributions to Growth of Real Output in the Market Economy, European Union and the United States, 1980–2004
(annual average growth rates, in percentage points)

		European Union		United States	
		1980–1995	*1995–2004*	*1980–1995*	*1995–2004*
1	Market economy output (2) + (3)	1.8	2.2	3.0	3.7
2	Hours worked	−0.6	0.7	1.4	0.6
3	Labor productivity (4) + (5) + (8)	2.4	1.5	1.5	3.0
	Contributions from				
4	Labor composition	0.3	0.2	0.2	0.3
5	Capital services per hour (6) + (7)	1.2	1.0	0.8	1.3
6	ICT capital per hour	0.4	0.5	0.5	0.8
7	Non-ICT capital per hour	0.8	0.5	0.2	0.4
8	Multifactor productivity	0.9	0.3	0.5	1.4
	Contribution of the knowledge economy to labor productivity (4) + (6) + (8)	**1.6**	**1.1**	**1.3**	**2.6**

Source: EU KLEMS database, see Timmer, O'Mahony, and van Ark (2007).
Notes: Data for European Union refers to ten countries: Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Spain, and the United Kingdom. "ICT" is information and communications technology.

productivity growth in the U.S. market economy doubled compared to a large slowdown in Europe after 1995.

Table 3 shows that changes in labor composition contributed 0.2–0.3 percentage points to labor productivity growth both in the European Union and the United States during this entire time period. Even though this contribution is small, its positive sign implies that the process of transformation of the labor force to higher skills has proceeded at roughly equal rates in Europe and the United States, thus confirming the observation above that Europe has not raised its share of low-skill workers. Instead the upward trend in the skill-content of the employees shows that newcomers on the labor market have had on average more schooling than the existing labor force.

Concerning the total contribution of capital deepening to labor productivity growth, measured by capital services per hour, Table 3 shows somewhat larger differences between the European Union and the United States compared to labor composition. This contribution declined in Europe while rising in the United States between the two time periods. The specific contribution of information and communications technology per working hour in Europe has been lower than in the United States, and since 1995, it accelerated more slowly (Timmer and van Ark, 2005). This slower uptake in deepening of information and communications technology capital is in part related to the overall decline in capital–labor ratios across Europe since the mid 1990s, as European employment grew rapidly.

The largest difference between the European Union and the United States shown in Table 3 is in the contribution of multifactor productivity growth. Whereas multifactor productivity growth in the United States accelerated almost a full percentage point from 0.5 percent from 1980–1995 to 1.4 percent from 1995–2004, the same measure declined from 0.9 to 0.3 percent between these two periods in the European Union. As a residual measure, multifactor productivity has multiple interpretations, but in some way it does reflect the overall efficiency of the production process. Its reduced growth rate is therefore a major source of concern across Europe.

When looking at these growth accounts from the perspective of the emerging knowledge economy, one might focus on the summed contributions of three factors: direct effects from investments in information and communication technology; changes in labor composition mostly driven by greater demand for skilled workers; and multifactor productivity growth, which—as indicated above—might include the impact of intangible investments such as organizational changes related to the use of information technology. Table 3 shows that the combined contribution of these three factors to labor productivity growth declined by 0.5 percentage points in Europe between the two time periods, from 1.6 percentage points from 1980–1995 to 1.1 percentage points from 1995–2004. In contrast, in the U.S. economy the contribution of these three knowledge economy components doubled from 1.3 percentage points from 1980–1995 to 2.6 percentage points from 1995–2004.

There is a large variation in labor productivity growth across European countries. Similar to the rows in Table 3, the first column of Table 4 shows the growth rate of output for 10 European countries over the 1995–2004 time period. The second and third columns divide that growth in output into changes in hours worked and changes in output per hour, or labor productivity. Columns 4–7 divide up the growth in labor productivity into the contributions from four factors: changes in labor composition; investments in information and communication technology capital; other types of physical capital; and multifactor productivity.

One key observation to be drawn from this table is that the main difference in labor productivity growth between individual European economies and the United States is to be found in multifactor productivity, not in differences in the intensity of the production factors. Indeed the bottom row shows that the standard deviation for multifactor productivity growth across the set of countries is by far the largest, ranging from minus 0.9 percent in Spain to plus 1.4 percent in the United States. By way of illustration, the difference in the contribution of capital deepening in information and communications technologies between a high investor like the United States and a low investor like Italy explains 0.6 percentage points out of a labor productivity growth difference of 2.5 percentage points during 1995–2004. The remaining 1.9 percentage point difference is accounted for by the differences in multifactor productivity growth. Differences in multifactor productivity seem to have driven the divergence in labor productivity between European countries too. In Belgium and Germany, multifactor productivity growth is well below 0.5 percent

Table 4
Contributions to Growth of Real Output in the Market Economy, EU Economies and the United States, 1995–2004
(annual average growth rates, in percentage points)

		Output contribution from		Labor productivity contributions from				
	Growth rate of output	*Hours worked*	*Labor productivity*	*Labor composition*	*ICT capital per hour*	*Non-ICT capital per hour*	*MFP*	*Labor productivity contribution from knowledge economy*
	1 = 2 + 3	*2*	*3 = 4 + 5 + 6 + 7*	*4*	*5*	*6*	*7*	*4 + 5 + 7*
Austria	2.6	0.4	2.2	0.2	0.6	0.1	1.2	2.1
Belgium	2.4	0.6	1.8	0.2	0.7	0.4	0.4	1.4
Denmark	2.3	0.9	1.4	0.3	1.2	0.3	−0.4	1.1
Finland	4.4	1.1	3.3	0.1	0.5	−0.1	2.8	3.4
France	2.5	0.4	2.0	0.4	0.5	0.4	0.8	1.6
Germany	1.0	−0.6	1.6	0.1	0.5	0.6	0.3	1.0
Italy	1.4	1.0	0.5	0.1	0.2	0.6	−0.4	−0.1
Netherlands	2.8	0.8	2.0	0.2	0.6	0.1	1.0	1.9
Spain	3.6	3.3	0.2	0.4	0.3	0.4	−0.9	−0.2
United Kingdom	3.3	0.7	2.7	0.5	1.0	0.4	0.7	2.2
European Union	2.2	0.7	1.5	0.2	0.5	0.5	0.3	1.1
United States	3.7	0.6	3.0	0.3	0.8	0.4	1.4	2.6
Standard deviation**	1.0	0.9	1.0	0.1	0.3	0.2	1.0	1.1

Source: Calculations based on EU KLEMS database, see Timmer, O'Mahony, and van Ark (2007).
Notes: "ICT" is information and communications technology. "MFP" is multifactor productivity. Data for Italy excludes agriculture and private households. Data for the European Union refers to the ten countries in the table. Numbers may not sum exactly due to rounding.
** Standard deviation for EU countries and the United States.

per year, and in Denmark, Italy, and Spain, it is even negative. Only Finland exceeds the U.S. growth rate of multifactor growth in the market economy, and Finland is a special case that will be discussed in more detail in the next section.

How should we explain the large differences in multifactor productivity growth across countries? In the next section, a division of the aggregate market economy measures by industry focuses attention on the performance of the market services sector.

Structural Change and Sectoral Productivity Growth

Both Europe and the United States have experienced a major shift of production and employment from manufacturing and other goods-producing industries (such as agriculture and mining) towards services. Market services include a wide variety of activities, ranging from trade and transportation services, to financial and business services, and also hotels, restaurants, and personal services. Over the period 1980–2004, the share of labor input going to manufacturing has typically declined by one-third or more in most countries. Market services now account for almost half of the market economy employment in all countries and the share of total labor hours going to market services is not much lower in Europe than in the United States. While there are differences across European countries, even in Germany, a country in which manufacturing traditionally plays an important role, the number of hours worked in market services is now more than 2.5 times larger than in manufacturing.

The growing importance of market services is the result of a number of interacting forces (Schettkatt and Yocarini, 2006). Higher per capita income leads to higher demand for services. There is also an increasing marketization of traditional household production activities, including services like dining outside the home, cleaning, and care assistance. Finally, many manufacturing firms are outsourcing aspects of business services, trade, and transport activities. Whatever the underlying causes of the shift from manufacturing to services, it has important implications for productivity growth. Traditionally, manufacturing activities have been regarded as the locus of innovation and technological change, and thus the central source of productivity growth. For example, more productive manufacturing was the key to post–World War II growth in Europe through a combination of economies of scale, capital intensification, and incremental innovation. More recently, rapid technological change in computer and semiconductor manufacturing seemingly reinforces the predominance of innovation in the manufacturing sector. In contrast, the increasing weight of services in output was thought to slow aggregate productivity growth. Baumol (1967) called this the "cost disease of the service sector." The diagnosis of the disease argues that productivity improvements in services are less likely than in goods-producing industries because most services are inherently labor-intensive, making it difficult to substitute capital for labor in service industries. Although Baumol originally mainly referred to services activities like education, health, and public services, it was widely believed to hold for many other services sectors as well. This hypothesis has subsequently been disputed in the literature (for example, Triplett and Bosworth, 2006) and, as the following discussion will show, is not supported by the evidence from the EU KLEMS data.

To evaluate the effect of structural changes on productivity growth, we need to look at the contributions of individual sectors on the aggregate economy. Table 5 shows overall labor productivity growth for the market economy split into contributions from labor productivity growth in the information-and-communications-technology production sector (including production of electrical machinery and telecommunication services), goods production (including agriculture, mining, manufacturing other than electrical machinery, utilities, and construction), and the market services sector (including trade, hotels and restaurants, transport services, financial and business services, and social and personal services), each

Table 5
Major Sector Contribution to Average Annual Labor Productivity Growth in the Market Economy, 1995–2004
(annual average growth rates, in percentage points)

	Market economy	*ICT production*	*Goods production*	*Market services*	*Reallocation*
	1 = 2 + 3 + 4 + 5	*2*	*3*	*4*	*5*
Austria	2.2	0.3	1.7	0.3	−0.1
Belgium	1.8	0.3	1.0	0.5	−0.1
Denmark	1.4	0.3	0.8	0.3	0.0
Finland	3.3	1.6	1.3	0.4	0.0
France	2.0	0.5	1.0	0.6	0.0
Germany	1.6	0.5	0.9	0.2	0.0
Italy	0.5	0.3	0.3	−0.1	0.0
Netherlands	2.0	0.4	0.6	1.1	−0.1
Spain	0.2	0.1	0.1	0.1	−0.1
United Kingdom	2.7	0.5	0.7	1.6	−0.2
European Union	1.5	0.5	0.8	0.5	−0.2
United States	3.0	0.9	0.7	1.8	−0.3

Source: Calculations based on EU KLEMS database, see Timmer, O'Mahony, and van Ark (2007).
Notes: The reallocation effect in the last column refers to labor productivity effects of reallocations of labor between sectors. The European Union aggregate refers to ten countries in the table. Information and communications technology production includes manufacturing of electrical machinery and post and telecommunications services. Goods production includes agriculture, mining, manufacturing (excluding electrical machinery), construction, and utilities. Market services include distribution services; financial and business services, excluding real estate; and personal services. Numbers may not sum exactly due to rounding.

weighted by its share in value added, along with an adjustment in the final column for the reallocation of hours between industries with different productivity.

Table 5 shows that slow productivity growth in market services is not a universal truth, even among advanced countries with large service sectors. First, productivity growth in market services has been much faster in the United States than in Europe. At an average annual growth rate of 0.9 percent, market services contributed only 0.5 percentage points to labor productivity growth in Europe from 1995–2004. In contrast, labor productivity in market services increased at 3.2 percent in the United States, contributing 1.8 percentage points to U.S. productivity growth. Secondly, within Europe two countries—the Netherlands and the United Kingdom—also showed rapid productivity growth in market services. Market services in the United Kingdom contributed almost as much to aggregate labor productivity growth as in the United States, mainly due to strong performance in trade and business services industries. Incidentally, market services also appear to exhibit rapid productivity growth in other Anglo-Saxon economies, such as Australia and Canada (Inklaar, Timmer, and van Ark, 2007). In contrast, Germany, Italy, and Spain show almost zero contributions from market services to aggregate labor productivity growth. Previous studies on the growth differential between Europe and the United States also stressed the differentiating role of market services (O'Mahony and van Ark, 2003; Losch, 2006; Inklaar, Timmer, and van Ark, 2008).

The importance of market services for the productivity growth gap between Europe and the United States dwarfs the differences for other major sectors. Even though the United States has a somewhat bigger share in information and communications technology–producing sectors, the productivity growth rates in these sectors are not dramatically different. As a result, the effect on the aggregate growth differential is only 0.4 percentage points (0.9 percent in the United States compared to 0.5 percent in Europe). Goods production seems to be equally important for aggregate productivity growth in both regions. The contribution from labor productivity growth in goods production in Europe is still bigger than that of market services, despite its relative size of only one-third of market services value added. For example, in France and Germany, manufacturing industries like machinery and car manufacturing are still important sources of productivity growth. In Spain and Italy, lackluster performance is not only due to slow growth in market services, but also in manufacturing, as traditional labor-intensive sectors have faced a particularly tough challenge from increasing low-wage competition from eastern Europe and China.

A more in-depth focus on market services reveals that cross-Atlantic growth differences were especially large in distributive trade and in financial and business services. In Table 6 we focus on the contribution of three major groups of market services industries—namely distributive trade (including retail and wholesale trade, and transport services); financial and business services; and personal services (including hotels and restaurants, and personal, community, and social services)—to labor productivity growth in aggregate market services. In Europe, the distribution sector contributed 0.6 percentage points to average annual labor productivity growth in market services from 1995 to 2004, compared to 1.6 percentage points in the United States. In finance and business services, the gap was even bigger, at a 0.1 percentage point contribution in Europe relative to 1.2 percentage points in the United States. Drilling more deeply into the data, it turns out that for both sectors, multifactor productivity and not factor intensity was the key to the productivity growth differential between Europe and the United States. Differences in "factor intensity", which include the total contribution from changes in labor composition and deepening of all types of capital, appear very small. The fuelling of U.S. multifactor productivity growth from trade, finance, and business services is confirmed in studies by Jorgenson, Ho, and Stiroh (2005) and Triplett and Bosworth (2006).

Because multifactor productivity growth represents a multitude of factors which are not explicitly measured in a growth accounts framework, it is useful to look at what might lie behind this growth. While the factors may differ across sectors, the example of the retail sector may serve as an illustration of the complex interactions between productivity, investment, and regulations. Over the past 25 years, the retail sector has undergone a substantial transformation due to benefits

Table 6
Contributions of Sectors to Average Annual Labor Productivity Growth in Market Services, 1980–2004
(in percentage points)

	European Union		United States	
	1980–1995	*1995–2004*	*1980–1995*	*1995–2004*
Market services labor productivity	1.6	0.9	1.5	3.2
Distribution services contribution	1.1	0.6	1.1	1.6
from factor intensity growth	0.5	0.5	0.5	0.6
from multifactor productivity growth	0.6	0.2	0.6	1.0
Finance and Business services contribution	0.2	0.1	0.3	1.2
from factor intensity growth	0.5	0.6	0.4	0.8
from multifactor productivity growth	−0.3	−0.5	−0.1	0.4
Personal services contribution	0.0	−0.1	0.0	0.2
from factor intensity growth	0.1	0.1	0.0	0.2
from multifactor productivity growth	−0.2	−0.2	0.0	0.0
Contribution from labor reallocation	0.3	0.2	0.1	0.2

Source: Calculations based on EU KLEMS database (Timmer, O'Mahony, and van Ark, 2007).
Notes: European Union aggregate refers to 10 countries, as listed in Table 5. Factor intensity relates to the total contribution from changes in labor composition and in capital deepening of information and communications technology (ICT) and non–information and communications technology (non-ICT) assets. The reallocation effect refers to the impact of changes in the distribution of labor input between industries on labor productivity growth in market services. Numbers may not add up due to rounding.

from the increased use of information and communications technology, commonly referred to as the "lean retailing system" (Abernathy, Dunlop, Hammond, and Weil, 1999). The retail industry has changed from a low-tech industry where workers mainly shift boxes from the producer to the consumer depending on availability in stock, into an industry whose main activity is trading information by matching the production of goods and services to customer demand on a continuous basis. Various studies, including McKinsey Global Institute (2002), Baily and Kirkegaard (2004), Gordon (2004), and McGuckin, Spiegelman, and van Ark (2005) have discussed the reasons for superior performance in the U.S. retail industry relative to Europe.

While there is significant evidence of a faster rise in information and communications technology capital in the U.S. retail sector compared to Europe, the productivity impact of the greater use of barcode scanners, communication equipment, inventory tracking devices, transaction processing software, and similar equipment may be understated when focusing solely on the contribution of investment as directly measured in growth accounts. The use of information and communications technology also provides indirect benefits for growth as measured by multifactor productivity through increasing the potential for other kinds of innovation. These innovation effects should in part be realized through "softer" innovations, such as the invention of new retail formats, service protocols, labor scheduling systems, and optimized marketing campaigns (McKinsey Global Institute, 2002).

Others have emphasized the role of "big box" formats, as exemplified most notably by the emergence of Wal-Mart, as the engine of productivity growth in U.S. retailing (Basker, 2007). From this perspective, Europe's lagging behind in productivity is due to more restrictive regulations like store-opening hours; to land zoning and labor markets; and to cultural differences that inhibit a rapid increase in market share of new large-scale retail formats. These new large-scale retail formats have been a main driver of growth in the United States, both because of increased competitive pressures on incumbent firms and the higher productivity levels of new entrants (Foster, Haltiwanger, and Krizan, 2006). In addition, deregulation in upstream industries such as trucking in the 1980s was necessary for the lean retailing model to work, because it allowed for more efficient ordering and shipping schedules.

The Future of European Productivity Growth

Since the mid 1990s, the European Union has experienced a significant slowdown in productivity growth, at a time when productivity growth in the United States significantly accelerated. The resurgence of productivity growth in the United States appears to have been a combination of high levels of investment in rapidly progressing information and communications technology in the second half of the 1990s, followed by rapid productivity growth in the market services sector of the economy in the first half of the 2000s. Conversely, the productivity slowdown in European countries is largely the result of slower multifactor productivity growth in market services, particularly in trade, finance, and business services. This pattern holds true for Europe as a whole, and also for many individual European countries.

While Europe needs to find mechanisms to exploit service innovations for greater multifactor productivity growth, the traditional catch-up and convergence model of the 1950s and 1960s may not help Europe get back on track. First, because Europe had reached the productivity frontier by the mid 1990s, it now may require a new model of innovation and technological change to make better use of a country's own innovative capabilities (Acemoglu, Aghion, and Zilibotti, 2006). Arguably innovations in services are more difficult to imitate than "hard" technologies based in manufacturing. The greater emphasis on human resources, organizational change, and other intangible investments are strongly specific to individual firms. Moreover, the firm receives most of the benefits of such changes, which reduces the legitimization for government support such as research and development and innovation subsidies to support "technology" transfer in services. Service activities also tend to be less standardized and more customized than manufacturing production; they depend strongly on the interaction with the consumer and are therefore more embedded in national and cultural institutions. In this situation, the spillover of technologies across firms and nations becomes much more difficult. Recent work by Bloom and Van Reenen (2007) links corporate management practices to productivity. They find significant cross-country differences in corporate management practice, with U.S. firms being better managed than European firms on average, as well as significant within-country differences with a long tail of badly managed firms. In other words, a simple "copying" of practices from other countries— or even from other firms within the same country—is not the most likely way for European service companies to attain greater productivity growth.

Second, a more flexible approach towards labor, product, and capital markets in Europe would allow resources to flow to their most productive uses. Crafts (2006) discusses the increasing evidence that restrictive product market regulations, in particular those limiting new entry, hinder technology transfer and have a negative impact on productivity, although most studies relate only to manufacturing industries. The diversity in productivity growth across European countries shows that some countries have been addressing these issues relatively successfully, while others have not. Even though most European countries have begun to make changes to institutional arrangements that increase flexibility and competitiveness in labor and product markets, such changes vary greatly across countries. The changes that have occurred depend, for example, on the size and maturity of the industry, the industry concentration, the nature of the education system, the availability of capital for startups, the sophistication of the consumer, and the characteristics of the legislative framework. More research is needed to understand the determinants of the differences in country experiences regarding innovation and regulations, in particular in services industries.

Finally, many service industries in Europe could benefit from a truly single market across Europe, in which competition can be strengthened and scale advantages may be realized. Of course, the European "single market" program has since the 1980s aimed at removing the barriers to free movement of capital, labor, and goods, but the effect on the services industry is generally seen as limited. The present drive in Europe towards a greater openness of service product markets, for example through the adoption of a Services Directive in 2006 specifically aimed at creating a common market for services across the European Union, may hold the potential to increase productivity growth across Europe in the coming decade.

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Appendix

Measurement of Output, Labor, and Capital Services in the EU KLEMS Data

This appendix provides a short nontechnical summary of the measurement of output, input, and productivity in the EU KLEMS database. For a more detailed treatment, see Timmer, O' Mahony, and van Ark (2007).

Investment and Capital Services

The availability of investment series by asset type and by industry is one of the unique characteristics of the EU KLEMS growth accounts. They are based on series obtained from national statistical institutes, allowing for a detailed industry-by-asset analysis. Importantly, we make a distinction between three information and communications technology assets— office and computing equipment, communication equipment, and software—and three non–information and communications technology assets—transport equipment, other machinery and equipment, and nonresidential structures. Residential capital is excluded from the analysis here. Deflators for computers are based on hedonic or high-frequency matched models, if available; otherwise the harmonization procedure suggested by Schreyer (2002) has been used. The real investment series are accumulated into stock estimates using the Perpetual Inventory Method (PIM) and the application of industry-specific geometric depreciation rates that are assumed equal across all countries. Next, capital service flows are derived by weighting the growth of stocks by the share of each asset's compensation in total capital compensation. In this way, aggregation takes into account the widely different marginal products from the heterogeneous stock of assets. The weights are related to the user cost of each asset. The user cost approach is crucial for the analysis of the contribution of capital to output growth and is based on the assumption that marginal costs reflect marginal productivity.

An example might help to illustrate the user cost approach. Suppose a firm leases a computer and a building for one year in the rental market. If the cost of renting one euro worth of computers is higher than the cost of renting one euro worth of buildings, computers have a higher marginal productivity, and this should be accounted for. There are various reasons why the cost of computers is higher than for buildings. While computers may typically be scrapped after five or six years, buildings may provide services for several decades. Besides, prices of new computers are rapidly declining and those of buildings are normally not. Hence the user cost of computers is typically 50 to 60 percent of the investment price, while that of buildings is less than 10 percent. Therefore one euro of computer capital stock should get a bigger weight in the growth decomposition than one euro of building stock. This difference is picked up by using the rental price of capital services.

Labor Composition

The productivity of various types of labor, such as low- versus high-skilled labor, will differ across components. Standard measures of labor input, such as number of persons employed or hours worked, will not account for such differences. Hence it is important that measures of labor input take account of the heterogeneity of the labor force in measuring productivity and the contribution of labor to output growth. In the growth accounting approach, these measures are called labor services, as they allow for differences in the amount of services delivered per unit of labor. It is assumed that the flow of labor services for each labor type is proportional to hours worked, and workers are paid their marginal productivities. Then the corresponding index of labor services input is given by the growth rate of hours worked by each labor type weighted by the period average shares of each type in the value of labor compensation. In this way, aggregation takes into account the changing composition of the labor force. We cross-classify labor input by educational attainment, gender, and age (to proxy for work experience) into 18 labor categories (respectively 3 x 2 x 3 types).

Typically, a shift in the share of hours worked by low-skilled workers to medium- or high-skilled workers will lead to a growth of labor services which is bigger than the growth in total hours worked. We refer to this difference as the labor composition effect. This difference is also known as "labor quality" in the growth accounting literature (for example, Jorgenson, Ho, and Stiroh, 2005). However, this terminology has a normative connotation which can lead to confusion. For example, lower female wages would suggest that hours worked by females have a lower "quality" than hours worked by males. Instead, we prefer to use the concept of "labor composition."

Measurement of Market Services Output

It has been suggested that part of the productivity growth gap between European countries and the United States could be due to differences in the measurement of services output. The measurement of output is in general much more challenging in services than in goods-producing industries. Indeed, Griliches (1994) classified a large part of the services sector as "unmeasurable." Most measurement problems boil down to the fact that service activities are intangible, more heterogeneous than goods, and often dependent on the actions of the consumer as well as the producer. While the measurement of nominal output in market services is generally straightforward, being mostly a matter of accurately registering total revenue, the main bottleneck is the measurement of output volumes, which requires accurate price measurement adjusted for changes in the quality of services output. A prominent exception is the measurement of banking output, which still needs a suitable conceptual framework (Wang, Basu, and Fernald, 2004).

There is no doubt that problems in measuring services output still exist, but the data situation is much better than say two decades ago. In recent years, many statistical offices have made great strides forward in measuring the nominal value and prices of services output; for examples, see the general overview for the United States by Abraham (2005) and in-depth industry studies in Triplett and Bosworth (2004). Inklaar, Timmer, and van Ark (2008) provide an assessment of statistical practices in European countries and conclude that measurement problems are most severe in finance and business services. However, the scope of measurement problems should not be overstated: on average only about a quarter of output is deflated using inappropriate (and thus potentially misleading) deflators, while for the remainder at least acceptable methods are used, as defined by Eurostat, the Statistical Office of the European Union. Thus, there is no evidence that differences in measurement practices bias international comparisons of productivity growth rates across countries.

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